

## CLAIMS

1. A piezoelectric ceramics having ceramic particles, wherein:

5           said ceramic particles comprises  
              bismuth layer compound containing at least Sr,  
              Ln (note that Ln is a lanthanoid element), Bi, Ti and O  
              and including  $M^{II}Bi_4Ti_4O_{15}$  type crystal ( $M^{II}$  is an element  
              composed of Sr and Ln) as a main component, and  
10           an oxide of Mn as a subcomponent; and  
              an average particle diameter by the code length  
              measuring method is 0.8 to 4.7  $\mu m$ .

2. The piezoelectric ceramics as set forth in  
15 claim 1, wherein said  $M^{II}Bi_4Ti_4O_{15}$  type crystal is  
              expressed by a composition formula  $(Sr_\alpha Ln_\beta)Bi_\gamma Ti_4O_{15}$ , and  
              "α" satisfies  $\alpha = 1-\beta$ , "β" satisfies  $0.01 \leq \beta \leq 0.50$  and  
              "γ" satisfies  $3.80 \leq \gamma \leq 4.50$ .

20           3. The piezoelectric ceramics as set forth in  
              claim 1 or 2, wherein a content of said oxide of Mn is  
              0.1 to 1.0 wt% in terms of  $MnO$ .

4. A piezoelectric element, comprising a  
25 piezoelectric substance formed by the piezoelectric  
              ceramics as set forth in any one of claims 1 to 3.

5. The piezoelectric element as set forth in  
              claim 4, wherein a maximum value  $Q_{max}$  of "Q" ( $Q = |X|/R$ ,  
30           wherein "X" is reactance and "R" is resistance) between a

resonant frequency and an antiresonant frequency with respect to a third harmonic wave of thickness vertical vibration at 24 MHz is 8 or larger.

5        6. A piezoelectric ceramics having ceramic particles, wherein:

      said ceramic particles comprises

      bismuth layer compound containing at least Ca,  
      Ln (note that Ln is a lanthanoid element), Bi, Ti and O  
10      and including  $M^{II}Bi_4Ti_4O_{15}$  type crystal ( $M^{II}$  is an element composed of Ca and Ln) as a main component, and  
      an oxide of Mn as a subcomponent; and  
      an average particle diameter by the code length measuring method is 1.0 to 4.5  $\mu m$ .

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7. The piezoelectric ceramics as set forth in claim 6, wherein said  $M^{II}Bi_4Ti_4O_{15}$  type crystal is expressed by a composition formula  $(Ca_{1-\beta}Ln_\beta)Bi_yTi_4O_{15}$ , and "β" satisfies  $0.01 \leq \beta \leq 0.5$  and "γ" satisfies  $3.80 \leq \gamma \leq 20$  4.20.

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8. The piezoelectric ceramics as set forth in claim 6 or 7, wherein a content of said oxide of Mn is 0.1 to 1.0 wt% in terms of  $MnO$ .

9. A piezoelectric element, comprising a piezoelectric substance formed by the piezoelectric ceramics as set forth in any one of claims 6 to 8.

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10. The piezoelectric element as set forth in

claim 9, wherein a maximum value  $Q_{\max}$  of "Q" ( $Q = |X|/R$ , wherein "X" is reactance and "R" is resistance) between a resonant frequency and an antiresonant frequency with respect to a third harmonic wave of thickness vertical  
5 vibration at 60 MHz is 6 or larger.

11. A piezoelectric ceramics having ceramic particles, wherein:

said ceramic particles comprises

10 bismuth layer compound containing at least Ba, Sr, Ln (note that Ln is a lanthanoid element), Bi, Ti and O and including  $M^{II}Bi_4Ti_4O_{15}$  type crystal ( $M^{II}$  is an element composed of Ba, Sr and Ln) as a main component, and

15 an oxide of Mn and an oxide of Ge as a subcomponent; and

an average particle diameter by the code length measuring method is 0.4 to 3.2  $\mu m$ .

20 12. The piezoelectric ceramics as set forth in claim 11, wherein

said  $M^{II}Bi_4Ti_4O_{15}$  type crystal is expressed by a composition formula  $(Ba_{1-\alpha-\beta}Sr_\alpha Ln_\beta)Bi_\gamma Ti_4O_{15}$ , and

25 "α" satisfies  $0.1 \leq \alpha \leq 0.6$ , "β" satisfies  $0.05 \leq \beta \leq 0.5$  and "γ" satisfies  $3.90 \leq \gamma \leq 4.30$  in said composition formula.

13. The piezoelectric ceramics as set forth in claim 11 or 12, wherein

30 a content of said oxide of Mn is 0.1 to 1.0 wt% in

terms of MnO<sub>2</sub>, and

a content of said oxide of Ge is 0.05 to 0.5 wt% in terms of GeO<sub>2</sub>.

5        14. A piezoelectric element, comprising a piezoelectric substance formed by the piezoelectric ceramics as set forth in any one of claims 11 to 13.

10      15. The piezoelectric element as set forth in claim 14, wherein a maximum value  $Q_{max}$  of "Q" ( $Q = |X|/R$ , wherein "X" is reactance and "R" is resistance) between a resonant frequency and an antiresonant frequency with respect to the fundamental wave of thickness-shear vibration at 8 MHz is 23 or larger.